THE WARRIOR

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Increased SPEK

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Cover photo: Airmen set up the serving line in a Single Pallet Expeditionary Kitchen during a field exercise at Barnes Air National Guard Base in Westfield, Mass. (Courtesy photo)

THE WARRIOR
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Wireless galley

Computerized system to control kitchen processes aboard Navy ships

By Curt Biberdorf
Editor

Even from a remote location, Navy food service supervisors will be able to continuously access and monitor kitchen functions with the Smart Galley Process Control System.

The Smart Galley, being developed by the Systems Equipment and Engineering Team at the Department of Defense Combat Feeding Directorate, located at the U.S. Army Soldier Systems Center in Natick, Mass., will take food service management to a new level.

"The Navy is in the process of streamlining equipment functionality to reduce maintenance and save labor," said Ken Ryan, project officer. "With future ship designs carrying fewer sailors, it's especially important to increase efficiency."

The Smart Galley concept was first demonstrated last summer during the Combat Feeding Research and Engineering Board conference after retrofitting a sub-hatchable convection oven with an electronic controller from Food Automation-Service Techniques, Inc., and connecting it to an online management software system provided by Smart Commercial Kitchen.

A two-way telemetry wireless station was set up to communicate if the oven was on or off, if the door was open or closed, and set temperature vs. actual temperature. Although the demonstration focused solely on a temperature probe and on a single kitchen item, the capability is much more, according to Ryan.

"This system monitors, reports and alerts," he said. "You want to know that the oven is working, when it started cooking and the status. You can tell if the temperature is too low or high to ensure food safety and quality. If a problem develops, it can send a message."

Data can be transferred wirelessly or through a local area network, and presented in a way the user prefers, according to Rob DiLalla, a mechanical engineer.

"We want a simple software interface," DiLalla said. "But it is another whole effort to develop a graphical user interface that's easy to use with the Smart Galley."

The team is working with Foster-Miller Inc. on a Small Business Innovation Research effort to build a mock galley at the Combat Feeding Navy Lab next summer before demonstrating it on a Navy platform.

"Ultimately, we want to build off the initial concept demonstration and enhance the use, diagnostic alerts and process control capabilities," Ryan said. "We also want to add more sensors to measure more critical process control points and variables."

A combi-oven, convection oven and dishwasher will lead the way followed by other food service appliances such as the griddle, steam kettle, steam table, skittle, refrigerator and freezer to form a total Smart Galley.

The mock galley will include the ability to remotely respond to the information provided instead of just receiving it. One benefit is that it will save troubleshooting time and downtime because culinary specialists and supply officers can order necessary spare parts in advance to replace them, said DiLalla.

"There's not a lot of historical data on how equipment wears out," Ryan said. "This system could allow us to track it and anticipate equipment failures."

Other benefits could be recipe management and inventory control. Ryan said the appliances could be programmed for breakfast, lunch and dinner to save time preparing meals. Still, in case of a network or computer malfunction, manual controls will still be accessible.

The Smart Galley will be consistent with the North American Association of Food Equipment Manufacturers (NAFEM) data protocol. The association completed in 2003 the industry standard that allows independent pieces of food service equipment to communicate with a computer.

Ryan said the Smart Galley technology could transition to the other branches of the military for their food service operations.

Courtesy photo

A sub-hatchable convection oven was retrofitted with an electronic controller last summer to demonstrate the Smart Galley concept.

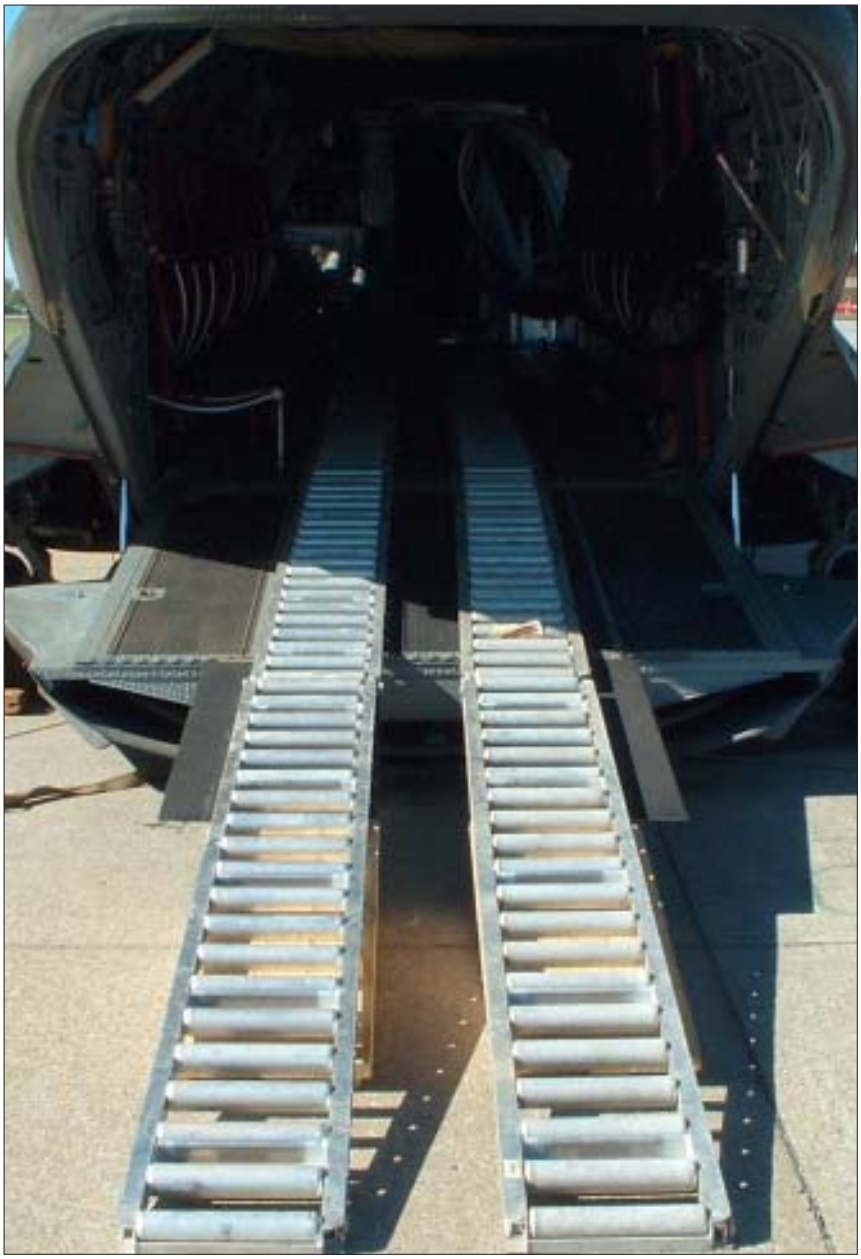
Roll aid

Chinook cargo ramp hastens delivery, leaves passenger room

By Curt Biberdorf
Editor

Bad enough spending time and effort muscling a loaded pallet of supplies off a CH-47 helicopter, cargo often got banged up when it tripped and tumbled out the door.

Help is on the way. A request for off-loading equipment last summer by a member of the Army's Rapid Equipping Force operating in Southwest Asia eventually led to the Aerial Delivery and Engineering Support Team at the U.S. Army Soldier Systems Center in Natick, Mass., developing a field-expedient fix within 90 days.



Courtesy photo

Two rows of commercially-available rollers enable Soldiers to quickly and easily push out cargo pallets from a CH-47 helicopter.

Commercially-available conveyor rollers along with wooden ramp extensions, complementing existing off-load extensions, provide a quick, easy and inexpensive way to move out cargo without sacrificing troop transit, said Bob Pitts, an equipment specialist and project officer for the CH-47 Rapid Off-Load.

"Everybody down there said 'I wish I would have had this when I was there,'" Pitts said about the pilots, crew chiefs and flight engineers with combat experience in Afghanistan and Iraq taking part in an evaluation at Fort Campbell, Ky.

After the evaluation, 120 roller systems were sent to Southwest Asia, with another order of 60 on the way.

Since the 1960s, the CH-47 Chinook helicopter has delivered troops and equipment to almost any type of terrain. They have been flown for airborne missions, casualty evacuation, downed aircraft recovery, disaster relief, and search and rescue missions during war and peace, according to Pitts.

He said flying cargo externally with a sling load is an option with the CH-47, but crews don't prefer it because extra drag reduces speed and increases fuel consumption, and because of the type of flying they do.

To keep it inside, the Helicopter Internal Cargo Handling System (HICHS) has been available for more than a decade. The system provides low-friction loading and unloading conveyor ramps along with conveyors for moving cargo within the aircraft.

"It's a good system for the loads that it is designed for, but it has drawbacks," Pitts said. "HICHS was not in there most of the time. Once configured, you want to leave it that way because it's difficult and time-consuming to install. The 463L pallet is too big to move around, and it doesn't allow any space to carry troops."

It also has limited availability, with the HICHS allocated to one-fourth

of the Chinook fleet. Operations in Afghanistan and Iraq renewed interest in internal cargo delivery and spurred field improvisation with locally-built "kick pallets," according to Pitts, which still allow room for passengers.

Kick pallets are double the length of the industry-standard warehouse pallet but half the size of the costlier 463L pallet. They often became snagged inside the helicopter and sometimes had to be pushed out as the helicopter took off, he said. Increased time in landing zones increased risk of enemy fire and tipped over pallets resulted in damaged supplies.

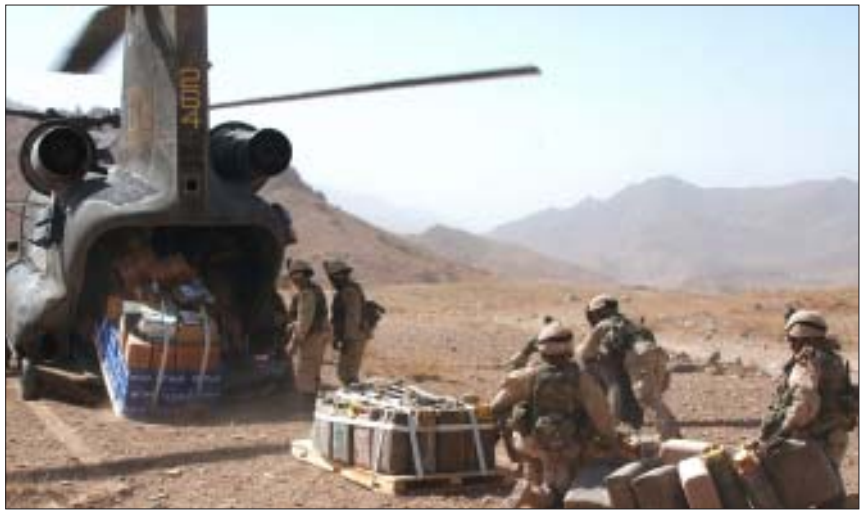
On the other hand, kick pallets placed in the center freed 20 passenger spaces on each side, keeping troops and their supplies together.

The Aerial Delivery and Engineering Support Team worked with packaging and materiel experts as well as CH-47 crew members to shape the requirements and design concepts leading to a system working with both kick pallets and warehouse pallets.

It met the criteria of allowing up to four pallets to be unloaded within 10 minutes, clearing the ramp area by 30 feet, giving enough pallet clearance without having to taxi the helicopter forward and working on any type of terrain. Chinooks with the new system can be configured to carry all cargo or a combination of passengers and cargo.

"We did nothing that modifies the aircraft at all. It's compatible with the armor protection," Pitts said. "We still get the same volumetric capacity as before without losing troop carrying capacity using rollers and pallets you can get anywhere."

The rollers, which could be wide or the thin skate-wheel variety, are ladder-shaped and strap down onto the cabin floor. When it's time to exit, the rollers are extended into place along with the wooden wedges slid underneath to support the weight as pallets move down the line.



Courtesy photo

Kick pallets without the roller system are off-loaded from a CH-47 helicopter in Southwest Asia.

Chances of a spilled pallet are lowered, and extra wood planks underneath the rollers help reduce friction when a pallet is pushed or pulled along the rollers.

Pitts said changes ahead might include adding a smooth surface underneath the pallets for extra stability on the rollers and developing a roller system based on the warehouse pallet.

A roller system using warehouse or kick pallets could also be added to light tactical vehicles, such as the Humvee, he said. With "stick on" cardboard honeycomb affixed to the side, it's possible to drop pallets directly from the rear of any vehicle or a helicopter.

Rollers are strapped onto the cabin floor and leave enough room for passengers along the sides (above). Wooden wedges slide underneath to support the weight of the pallets. (Courtesy photos)

Kitchen creep

SPEK includes equipment to prepare fresh rations

By Curt Biberdorf
Editor

Courtesy photo

The Single Pallet Expeditionary Kitchen is set up inside a tent.

"A" rations are taking the "S" out of SPEK.

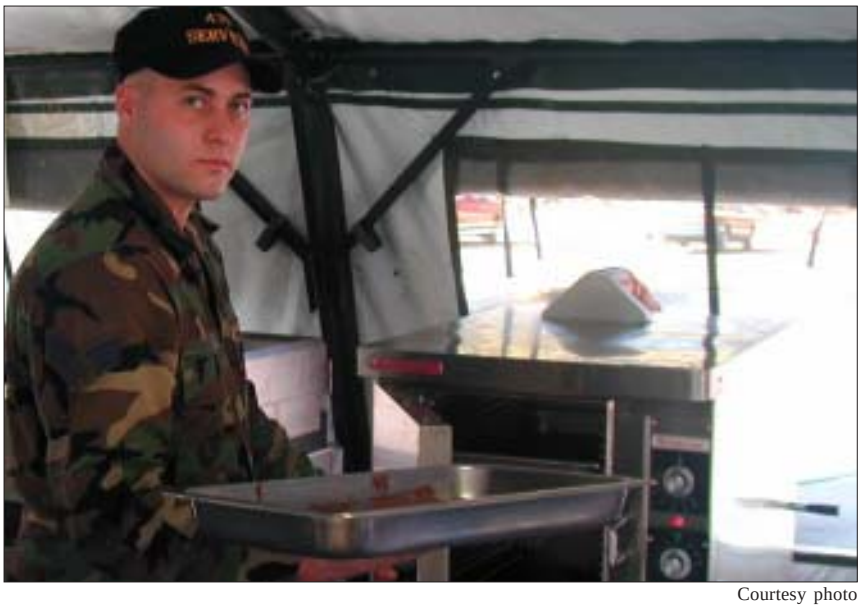
The Single Pallet Expeditionary Kitchen (SPEK), designed in 2002 by the Systems Equipment and Engineering Team at the Department of Defense Combat Feeding Directorate, located at the U.S. Army Soldier Systems Center in Natick, Mass., has grown to cook the top choice in field feeding options, A rations.

Initially capable of preparing heat and serve meals, the kitchen satisfies the Air Force requirement for a highly mobile, temporary kitchen on deployments to remote, undeveloped locations. Although the SPEK can still fit onto one C-130, 463L load pallet, extra equipment to prepare A-ration meals may eventually mean packing a second pallet for transit.

"We'll have the ability to serve fresh foods and extend deployment of the system," said Ken Ryan, project officer. "By expanding the equipment, we're expanding the capacity and don't have to rush to set up a bare base kitchen. It's going to evolve into a new kitchen, and we're going to have to come up with a new acronym."

An Expandable Small Air Mobile Shelter is another possible air or ground transportation platform to contain a larger version of the kitchen, according to Ryan. Regardless of how it travels, the items are easy to unpack, set up and operate, and then pack up for its next location.

With the changes, the kitchen can feed as many as 550 airmen, instead of 300 with the original SPEK, in a two-hour period twice a day for up to 45 days for heat and serve, and A rations. A user-test Nov. 6-7 with the Massachusetts National Guard 104th Fighter Wing in Westfield during its "Thunder Wart" exercise demonstrated how well it works.



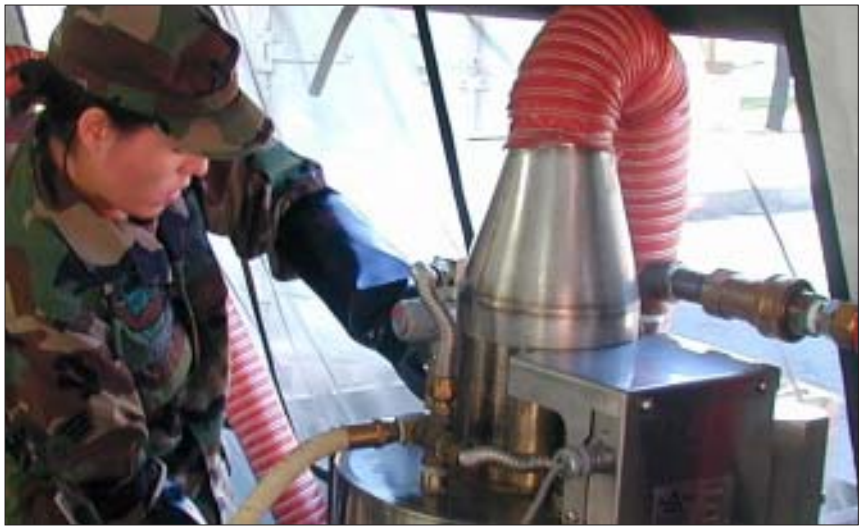
Courtesy photo

A cook loads a cake pan into a natural convection oven during a field exercise at Barnes Air National Guard Base in Westfield, Mass.

More than 550 airmen, including members of the Army's 226th Division Aviation Support Battalion, were fed in a two-and-a-half hour period, a remarkable feat because food personnel were trained that morning and warfighters had a choice of three entrees, two starches and two vegetables, said retired Navy Master Chief Louis Jamieson, an equipment specialist.

The SPEK carries everything except fuel, water and rations. A TEMPER or similar tent with interior lighting provides shelter for the cooking and serving equipment. The upgraded SPEK adds a 3-kilowatt generator to the 2-kilowatt generator to handle increased electrical demand, but a Spider temporary power distribution system can be used if higher-capacity power is available on-site, Ryan said.

Food storage and beverage containers, hand-washing stations, tables and the Multi Ration Heater—used for heat and serve tray rations and No. 10 food service cans—are the same, but the kitchen's sanitation center has been revised and floor-



Cooks can draw hot water from the kitchen's sanitation center (left) as well as clean pots and pans (below). The latest system was modified from a three-line into a more compact single in-line steam manifold. (Courtesy photos)

ing replaced.

Three lines were modified into a single in-line steam manifold that feeds water to three spargers independently controlled in each well for rinsing, washing and sanitizing for the sanitation center. A hose also provides hot water for coffee and reconstituted foods, such as mashed potatoes, while another spray hose can rinse kitchen utensils.

"Now the sanitation package is much more robust. There are fewer parts, less maintenance, and it decreased the amount of space it takes up," said Rob DiLalla, a mechanical engineer.

Flooring has been upgraded with a mat system manufactured by Soloco LLC. Key advantages are a non-skid rubberized surface with built-in drains, reduced weight, impact absorption and smooth edges, according to Anthony Cellucci, an engineering technician.

"The other flooring was brittle, it stained easily, was slick, had sharp edges and had snaps that tended to break when assembling the section together," he said.

New components that enable fresh rations to be prepared are the griddle, convection oven and a pressureless steamer.

Along with the sanitation center, each is connected to its own interchangeable burner base fed on common battlefield fuel in a closed system that yields no fumes or open flames, Ryan said. Temperature for each appliance is adjustable by a thermostat.

"Thermostatic controls are the biggest difference in any field kitchen," Jamieson said. "You get even cooking and heat distribution. You would have to guess the temperature otherwise."

He described the cooking uniformity of the griddle designed and soon-to-be patented by the team as "phenomenal," with no swings in surface temperature as hamburgers, pancakes or any other griddle-cooked foods are moved or turned.

Uniform baking is also heralded with the natural convection oven. Ryan said the design is unusual because it's a commercial product adapted to a burner, something not normally seen in the field.

The SPEK comes with a spare parts kit for quick repairs and replacements for the major components, and the entire platform can be arranged as desired by the cooks.

Air Force National Guard units are the first to see the redesigned SPEK, but Ryan said the kitchen could become valuable for other military services.

Courtesy photo

A griddle is one new piece of equipment that allows cooks to prepare A rations, such as hamburgers, in the SPEK.

Grey again

Dirty dishwater recycled after thorough cleaning

By Curt Biberdorf
Editor

Dump it on the ground or haul it away. Water sullied by food and soap from washing dishes in field kitchen sanitation sinks never had another chance until the Greywater Remediation and Recycling project started two years ago.

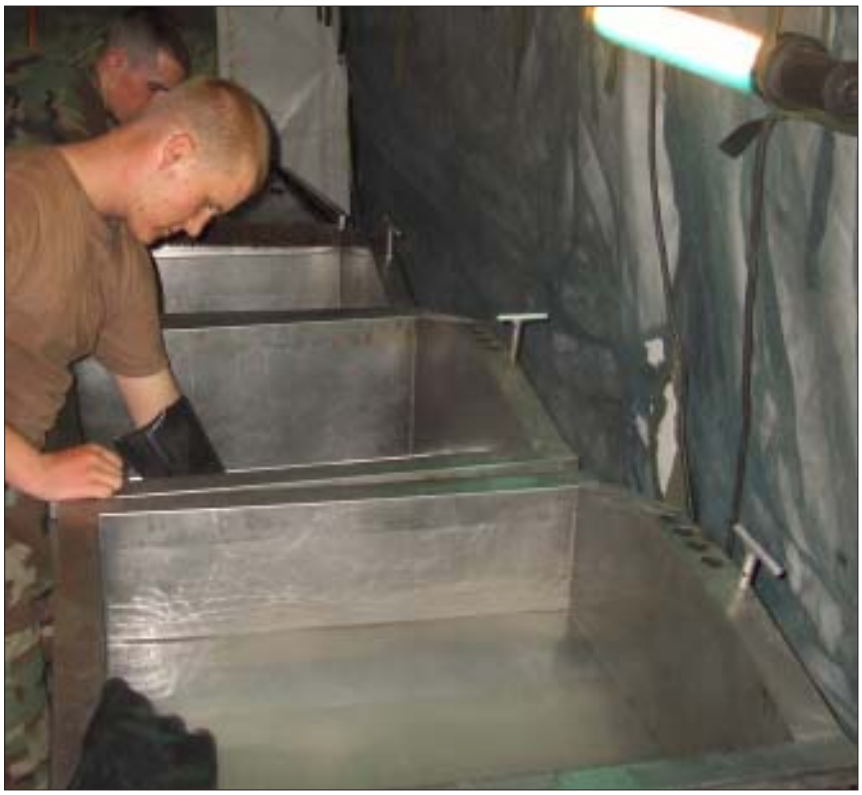
Cleaned and reused, the Army figures on cutting potable water consumption and the amount of greywater backhauling by two-thirds. With an estimated annual 20 million gallons of water now used nationwide for field sanitation, the Army also can expect to save money.

"It all goes back to the need for the Army to reduce logistics," said Chad Haering, a chemical engineer on the Equipment and Energy Technology Team at the Department of Defense Combat Feeding Directorate at the U.S. Army Soldier Systems Center in Natick, Mass. "(Water) is the heaviest commodity they have and extremely hard and expensive to move, and we know from Iraq, can be dangerous to transport. Reducing the demand for the use of water is going to reduce the Army logistics footprint."

Other benefits are a healthier environment because food particles and stagnating water attract pests and spread disease, and less work for the kitchen crew since digging a grease trap for greywater is complicated, according to Haering.

Pots, pans, utensils and other dishes are washed, rinsed and sanitized in the field with a three-sink food sanitation center that consumes nearly 250 gallons of potable water daily. Wastewater is either poured onto the ground, or stored in a tank or bladder for disposal.

The team is working with two technologies on the commercial market that have for decades been used for industrial applications, such as ultra-filtration for car washes, but only in recent years been manufactured small and lightweight enough to be practical for the military, according to Haering.



Courtesy photo

Water dirtied while cleaning dishes in a food sanitation center, now dumped or hauled away, can get recycled through a remediation system.

Two different ultra-filtration systems were tested for use with the Food Sanitation Center during a training exercise at Fort Lee, Va., last August.

The Splitter XD from Infinitex uses spiral-wound membranes for a high surface area in a compact space while the system from Bristol International Corp. uses 5-foot-long, 1-inch-diameter tubular membranes. Water flows parallel to the semi-permeable membrane, and the shearing action helps to reduce fouling.

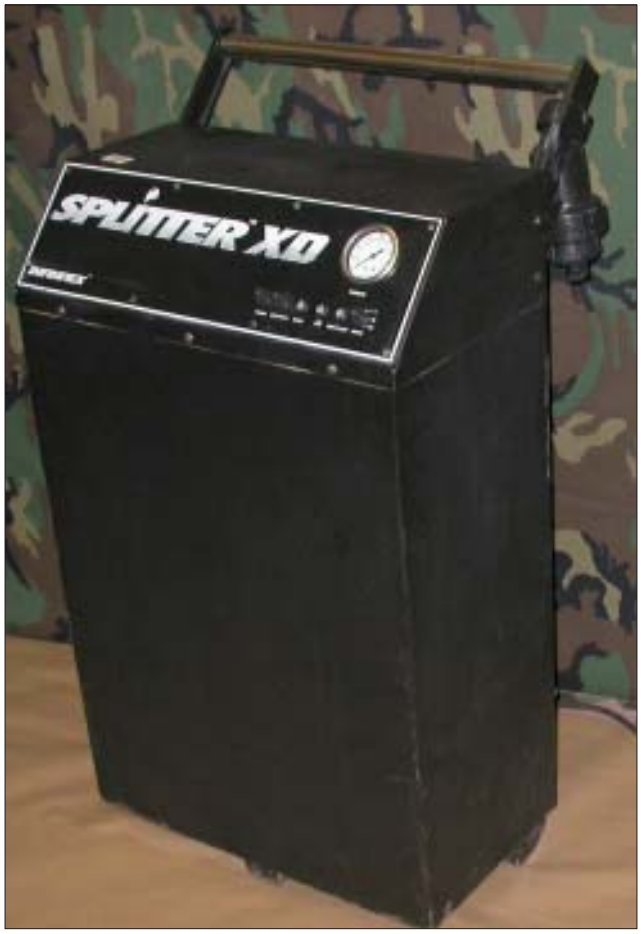
"(Ultra-filtration) is not as effective as reverse osmosis, but it's not meant for drinking water," Haering said.

A third product tested was a micro-distiller from Ovation Products Corp. Its vapor compression distillation process separates the water and impurities with a new technology allowing low-power consumption per gallon distilled in a compact package.

Both processes use a commer-

Courtesy photo

Spiral wound membranes found inside the Splitter XD offer a high surface area for filtration in a small space.



Courtesy photo

The Splitter XD from Infinitex filters greywater for reuse.

cial filter to pre-screen suspended solids, are low or no-maintenance, and are as easy to operate as flipping a switch.

Water quality was sampled before and after processing during the test, and analyzed in 12 categories. Testing proved 85-90 percent of the greywater could be recovered, leaving 10-15 percent of it concentrated sludge for backhauling.

Besides the high percentage of remediation, the test showed a permeation rate of 15-20 gallons per hour, fast enough to allow remediation to finish before the next meal. Between-meal remediation also balances demand on the kitchen generator, Haering said.

After testing, the Bristol was dropped as a candidate because of its size and number of tubes, he said, but the Infinitex and Ovation are still in the running although they posted mixed results.

"Water coming out of the Ovation is extremely high quality, but it's too heavy and too fragile," Haering said. "The Infinitex is lightweight and rugged enough, but the quality is not quite good enough."

Fixes for both are on the way. He said Ovation is designing a lighter, more rugged system and will have a prototype this April while Infinitex will benefit if the U.S. Army Center for Health Promotion and Preventive Medicine relaxes its standards.

"The standards now are that only potable water be used for washing and rinsing, but as soon as you start washing, the water gets dirty. If you can continue to wash dishes in slightly dirty water, you can use this reclaimed water," Haering said. "It's good enough for washing and rinsing, but the sanitation sink would still use potable water to not compromise safety."

Greywater remediation and recycling is also finding a home in a future field kitchen.

Connected to Combat Feeding's developmental Field Feeding Advanced Sustainment Technology kitchen, a steam-powered greywater recovery system from Advanced Mechanical Technologies Inc. (AMTI) distills water to remove contaminants.

AMTI's unit slides underneath the sink and can be disconnected so it can be packed for transit. Its 10-12 gallon per hour flow rate is slower than desired, but the sanitation center's water demand may be lower to meet the requirement of between-meal remediation, said Tony Patti, a mechanical engineer on the Equipment and Energy Technology Team.

With the initial phase finished, the team will continue with a one-year effort if additional funding from the Environmental Security Technology Certification Program is approved, said Haering.

Courtesy photo

A micro-distiller from Ovation Products Corp. uses a vapor distillation process to separate impurities from water.

Better barriers

New materials for chemical, biological protection sought for shelters

By Kristian L. Donahue
Contributing Writer

Collective protection shelters with chemical and biological agent protection have existed since the 1960s.

They historically have been heavy, cumbersome, carried a high logistic burden, and above all been very expensive, but research led by the Natick Soldier Center at the U.S. Army Soldier Systems Center in Natick, Mass., is on the path to developing a new generation of shelters to solve these challenges.

The U.S military now has only two viable options for chemical and biological (CB) protective materials. These options are either the expensive, high-performance, decontaminable material Tedlar/Kevlar or a lightweight, low-cost liner material, which has minimal physical properties, absorbs agent, is non-decontaminable, and carries the logistical burden of shipping, storage and deployment.

During the past several years, the Joint Science and Technology Panel for Chemical and Biological Defense has funded research to investigate and develop the next generation barrier materials for collective protection shelters.

The goal has been to develop a lightweight material with improved ultraviolet and flame resistance, increased durability, improved permeation properties, and decreased material and manufacturing cost compared to currently fielded materials.

To mitigate risk and provide incremental improvements to existing chemical and biological protective barrier fabrics, near-term, mid-term and long-term solutions have been identified and are currently being investigated.

These solutions are constantly being revised as new technologies emerge and existing technologies overcome technical barriers.

To date, the thrust of the research has been focused on fluoropolymer coatings as an after-market process for general-purpose shelter materials, nanotechnological enhancement of commodity polymers, low-temperature processible fluoropolymers and self-decontaminating barrier materials incorporating catalytically-reactive membranes.

Fresh coat

The near-term solution has been focused on improving barrier properties through coating general-purpose fabrics currently used in shelters. This approach has the lowest technical risk and is cost-effective. Its key advantage is providing a dramatic improvement in chemical and biological resistance to standard tent fabric with a minimal increase in weight.

Standard tent fabric is a woven polyester fiber with a polyvinyl chloride (PVC) coating.

This coating serves as both a repellent to liquids as well as a means of heat-sealing the fabric, thus increasing manufacturing efficiency.

A major laminating company, Duracote Corp. in Ravenna, Ohio, was contracted to laminate various low-temperature fluoropolymer films of varying thickness to one side and both sides of the fabric. Initial permeation testing results proved very promising.

The best candidate fabrics from the permeation testing were then subjected to physical testing to ensure the coatings didn't have any negative effects on the composite material, such as flame-resistance, infrared signature or interference with the ability to heat/radio frequency weld the fabric using conventional welding equipment.

Initial test results were very positive, and a limited production quantity of the new CB enhanced polyester/PVC fabric was ordered to build a prototype shelter and conduct operational testing.

Unfortunately, the material hit a technical snag from de-lamination and streaking, but researchers are attempting to overcome this technical barrier to provide a transitional near-term solution.

Nanoparticles

Approaches just ahead are nanotechnological enhancement of commodity polymers and lower-temperature processible fluoropolymers, which should transition within the next two to four years.

Courtesy photo

The Chemical Biological Protective Shelter uses a Teflon/Kevlar material to seal out contaminants.

Nanoscale particles introduced into commodity polymers improve barrier properties, and this technology has been applied in various industries, such as food packaging and pharmaceuticals.

Triton Systems, Inc. of Chelmsford, Mass., has successfully demonstrated the improvement in barrier properties for various polymer materials.

Through the introduction of nanoclay platelets at 5-10 percent by weight, barrier properties have increased 30-200 percent for a 10-20 mil thick film.

This increase in barrier properties also is accomplished without significantly changing the physical properties of neat polymers. Furthermore, these platelets have shown an improvement in flame and ultraviolet resistance for the composite.

Triton was contracted by the Army to improve the barrier properties of the currently fielded M-28 liner material as well as improve flame and ultraviolet resistance.

The polyvinylidene chloride (PVDC) barrier is a proven protective barrier. However, improving the flexibility of the barrier film and adding the capability to seal the material with radio frequency equipment could achieve a lower cost of production and manufacturing.

Triton has investigated several proprietary barrier films and demonstrated the improvement of the existing PVDC barrier properties through application of their nanocomposite technology. Initial testing showed a significant improvement in barrier properties through the application of nanocomposite platelets.

Live agent testing was also conducted on Triton's high barrier nanofilm, which showed excellent resistance.

The company is now working on scaling up their technology to produce a non-decontaminable CB-resistant tent liner similar to the M-28. They will also laminate a high-barrier film to a high-strength fabric substrate to produce a decontaminable outer skin fabric. These materials will then be tested and evaluated for physical as well as chemical and biological properties.

Courtesy photo

The M-28 liner uses a PVDC internal barrier with a high-density polyethylene scrim and low-density polyethylene protective coating.

Lower heat

Low-temperature processible fluoropolymers also have promise in improving CB protection.

An investigation of commercially-available fluoropolymers and chloropolymers of varying compositions was conducted with the goal of finding a low-temperature processible polymer with improved durability, ease of processing, or improved resistance to chemical and biological agents over the existing Teflon.

Once a candidate barrier material was identified, researchers then needed to find a compatible substrate material. The final composite also needed the physical properties of a general-purpose fabric, which meets military requirements, along with permeation resistance of conventional threat agents for 72 hours with no measured detection.

Federal Fabrics-Fibers Inc. (FFF), of Lowell, Mass., is contracted to produce a void-free lightweight fabric substrate with a chemical and biological barrier, and has successfully demonstrated the ability to produce a low-cost, lightweight, CB resistant, decontaminable fabric.

The company has identified a low-temperature fluoropolymer, which is easily processed with conventional equipment and can readily be heat-welded. The fluoropolymer laminate is also highly resistant to conventional decontamination solutions.

Initial testing of FFF's proprietary low-temperature processible fluoropolymer has shown very promising results, with little permeation in initial simulant testing and little mechanical degradation after decontamination.

FFF has scaled up their facilities and should have production capabilities in place by the end of 2004. Current work is being done to improve efficiency, quality and consistency of the entire process. A prototype shelter will be constructed to further conduct physical, chemical and biological testing on this novel outer skin fabric.

Self-cleaning

A long-term solution would involve a revolutionary new system such as a self-decontaminating barrier material incorporating catalytically-reactive membranes.

The Army is currently conducting a technology watch to monitor and identify promising new breakthroughs in academia, industry, government agencies and foreign military programs.

Technical barrier gaps, such as the selectivity of the chemical reactions or stability of required enzymes, will have to be bridged in order to become a viable technology for collective protection.

Editor's Note: Kristian Donahue is a chemical engineer in the Collective Protection Directorate at Natick Soldier Center.